

and *A. badius* in my collection I refer without hesitation to the latter species.

ÆGIALITIS GEOFFROYI (Wagl.).

One male (Kachka-kala, 15th April), just assuming the breeding-plumage.

ÆGIALITIS ASIATICA (Pall.).

One male (Lenkoran, 4th April), in full breeding-plumage.

VIII.—*An Attempt to Diagnose the Suborders of the Ancient Ardeino-Anserine Assemblage of Birds by the aid of Osteological Characters alone.* By HENRY SEEBOHM.

IN my last paper (*Ibis*, 1888, pp. 415–435) I endeavoured to diagnose the suborders of the great Gallino-Gralline group of birds by the aid of their osteological characters alone. I propose in the present essay to attempt to point out the distinguishing osteological features of the suborders of the ancient Ardeino-Anserine assemblage of birds. It is supposed that these two orders (as we may provisionally call them) are separated from each other by a great gulf, the Gallino-Gralline birds being regarded as schizognathous, and the Ardeino-Anserine birds as desmognathous. This distinction is not, however, a very satisfactory one. In the Gallinæ, for example, some of the Cracidæ, when old, become more or less desmognathous by the union of the maxillo-palatines with an ossified nasal septum, a form of desmognathism scarcely distinguishable from that of some of the Vultures and Owls. The narrowness of the line which separates the two orders is further shown by the remarkable similarity of the basipterygoid processes of the Anseres and the Gallinæ. Scarcely less remarkable is the prolongation and recurvation of the mandible behind its articulation with the quadrate, which is very similar in the two groups, though not exclusively confined to them. So close, indeed, are the Anseres to the Gallinæ that it has even been a disputed point (Garrod, *P. Z. S.* 1876, p. 189) to which of them the Palamedeidæ should be referred. It must also be con-

ceded that whilst the Anseres resemble the Gallinæ in many points, they differ from the Herodiones and their allies in an extraordinary manner. In the highly developed condition of the newly-hatched young the Anseres agree with the Gallinæ and differ from the other desmognathous groups. The thin maxillo-palatine plates of the Anseres and of the Gallinæ, though coalesced in the former and not in the latter birds, are in many respects more like each other than the thick spongy maxillo-palatine masses of the Herodiones and Steganopodes. Nevertheless the line between the Anseres and the Ciconiidae is so narrow that it is a disputed point to which group the Phœnicopteridæ belong (Gadow, J. f. Orn. 1877, p. 382).

It seems to me that the gaps which separate the orders of birds from each other are so very narrow, that it will require much sifting of the characters by which the various suborders may be diagnosed before satisfactory combinations can be discovered for the diagnosis of the larger groups.

The Ardeino-Anserine order of birds may be divided into six suborders, which may be distinguished from each other by the following osteological characters:—

a. Angle of mandible produced and recurved.

*a*¹. Bifurcation of nasals holorhinal.

*a*². No ribs furnished with uncinate processes PALAMEDEÆ.

*b*². Several ribs furnished with uncinate processes.

*a*³. Basipterygoid processes articulating with the pterygoid as near the palatines as possible ANSERES.

*b*³. No basipterygoid processes PHÆNICOPTERI.

*b*¹. Bifurcation of nasals schizorhinal. PLATALEÆ.

b. Angle of mandible truncated.

*c*¹. Tarsus much longer than the outer digit HERODIONES.

*d*¹. Tarsus shorter than the outer digit STEGANOPODES.

PALAMEDEÆ.

The Screamers are very remarkable birds. Only three or four species are known, which are all peculiar to South America. They appear to be archaic species, which differ from every other existing bird in a very important character.

They have no uncinatè processes to any of their ribs. Every other known living bird has uncinatè processes on several of its ribs*. Otherwise uncinatè processes are not only characteristic of, but almost peculiar to birds, being only found elsewhere in a very few reptiles. The Screamers appear to be one of the connecting-links between the Gallinæ and the Anseres. These two suborders are unique amongst birds in the character of their pterygoids, which articulate close to the palatines with very conspicuous basiptyergoid processes on the rostrum of the basisphenoid. They also agree in having the angle of the mandible produced beyond its articulation with the quadrate and much recurved. The eggs of the species belonging to the two groups present many points of resemblance, and in the condition of the newly hatched young they agree absolutely; but the Gallinæ are schizognathous and the Anseres are desmognathous. The desmognathism of the Anseres differs, however, so markedly from that of the Steganopodes and Herodiones, that it is easy to believe that it has been independently acquired, and consequently that the points of resemblance between the Gallinæ and the Anseres may have been inherited from a common ancestor.

The Palamedeæ may be diagnosed by the absence of uncinatè processes to the ribs.

They further possess the following osteological characters:—

1. They are heterocœlous in the articulation of their dorsal vertebræ.
2. They are holorhinal in the bifurcation of their nasals.
3. They have only one xiphoid process on each side of the median process of the posterior margin of the sternum.
4. They possess basiptyergoid processes which articulate with the pterygoids not far from the middle of those bones.
5. They have no lateral occipital fontanelles.
6. The angle of the mandible is much produced and recurved.

* The gigantic, but wingless, *Hesperornis regalis*, the remains of which are found in the cretaceous deposits of North America, had uncinatè processes to its ribs.

7. The palatines resemble most closely those of the Phœnicopteri, the laminae being widely separated.

8. The maxillo-palatines most closely resemble those of the Anseres, being thin plates fused with each other across the palate for their entire length.

Within the order they may be diagnosed not only by the absence of uncinate processes to the ribs, but by the 4th character. The combination of the 5th and 6th characters will distinguish them from every family except from the Cygnidæ.

Inasmuch as they agree with the Anseres in the 1st, 2nd, 3rd, 6th, and 8th characters, and with some of them in the 5th, they appear to be closely related to that group. In the other two characters, the 4th and 7th, they most resemble the Phœnicopteri, which are probably their next nearest relatives, though they differ from them in the 5th character.

ANSERES.

The Ducks, Geese, and Swans form a well-marked group of birds, which differ from all the other groups of the order in having basipterygoid processes which articulate with the pterygoids as near the palatines as possible. In this respect they differ from every other group of birds, with the single exception of the Gallinæ.

They possess the following osteological characters:—

1. They are heterocœlous in the articulation of their dorsal vertebræ.

2. They are holorhinal in the bifurcation of their nasals.

3. They have only one xiphoid process on each side of the median process of the sternum.

4. They have basipterygoid processes on the rostrum of the basisphenoid which articulate with the pterygoids as near as possible to the palatines.

5. They may or may not have lateral occipital fontanelles.

6. The angle of the mandible is much produced and recurved.

7. The laminae of the palatines are widely separated from each other, and are much narrower posteriorly and much broader anteriorly than in any of the allied suborders.

8. The maxillo-palatines, like those of the *Palamedeæ*, are thin plates fused with each other across the palate for their entire length.

The combination of the 3rd and 4th characters is absolutely diagnostic, and within the order the combination of the 2nd, 4th, and 6th characters is equally diagnostic.

In their geographical distribution they are almost cosmopolitan, and comprise two families, many genera, and about 180 species. They are very closely related to the *Palamedeæ*, and are probably not distantly allied to the *Phœnicopteri*.

The *Cygnidæ* differ so widely in their osteological characters from the *Anatidæ* that it is impossible to regard them as part of the same family. The number of cervical and cervico-dorsal vertebræ varies in the *Cygnidæ* from 23 to 25. No other living birds are known to possess so many: in the *Anatidæ* and in the *Plataleæ* and *Herodiones* their number varies from 16 to 19. The *Cygnidæ* further differ from the *Anatidæ* in having, when adult, no lateral occipital fontanelles* and in having very few dorsal vertebræ furnished with ventral processes.

The *Phœnicopteridæ* agree with the *Anatidæ* in the two first-mentioned of these characters, and with the *Cygnidæ* in the third, but they differ from both in other important characters.

PHŒNICOPTERI.

The *Flamingoes* are intermediate between the *Anseres* and the *Herodiones*, and appear to be closely related to the *Palamedeæ* and the *Plataleæ*. They possess the following characters:—

1. They are heterocœlous in the articulation of their dorsal vertebræ.
2. They are holorhinal in the bifurcation of their nasals.
3. They have only one xiphoid process on each side of the median process of the posterior margin of the sternum.

* This is a very unsafe character to rely upon, as young birds of many species of *Swans* show large lateral occipital fontanelles, and in very old *Ducks* they are sometimes ossified.

4. They have no basipterygoid processes*.

5. They have two lateral occipital fontanelles.

6. The angle of the mandible is much produced and recurved.

7. The laminae of the palatines are wide and widely separated, very closely resembling those of the Palamedæ.

8. The maxillo-palatines are fused with each other along their whole length, and are rather more spongy than in the Anseres, but not nearly so much so as in the Herodiones.

Within the order the combination of the 2nd, 4th, and 6th characters is diagnostic.

It is supposed that the newly hatched young of the Phœnicopteri differ from those of all the Gallino-Gralline order of birds (the Columbæ alone excepted), and also from those of the Palamedæ and Anseres, in being so helpless that they have to be fed for some time in the nest by their parents ; but the truth of this supposition has never been conclusively proved.

The Phœnicopteri scarcely number a dozen species, which are distributed in tropical America and in the tropics of the Old World west of Calcutta.

The Flamingoes are neither Storks nor Herons. They agree with the former in the 1st, 2nd, and 5th, and with the latter in the 3rd, 4th, 6th, 7th, and 8th characters, hereafter given as distinguishing these two families. They are unquestionably very near allies of the Herodiones, but their osteological characters suggest their still closer relationship to the Anseres.

PLATALEÆ.

The Spoonbills and Ibises are so closely related that they must be associated together in one suborder, which presents the following characters :—

1. They are heterocœlous in the articulation of their dorsal vertebræ.

* These are often represented by rudimentary prickles, which do not approach the pterygoids, and are situated at some distance from the palatines.

2. They are schizorhinal in the bifurcation of their nasals.
3. They have usually two xiphoid processes on each side of the median process of the posterior margin of the sternum.
4. They have no basipterygoid processes.
5. They have two lateral occipital fontanelles.
6. The angle of the mandible is slightly produced and recurved.

7. The palatines almost coalesce for a short distance after their articulation with the pterygoids; but as soon as they become expanded the laminae are at a distance from each other, in this respect resembling those of the Ciconiidae and Fregatidae.

8. The maxillo-palatines resemble those of the Herodiones and Steganopodes in being large and spongy, and fused with each other and the maxillary processes of the palatines.

Within the order the 2nd character is diagnostic.

The Plataleae number about thirty species, which are distributed throughout the tropical and subtropical continents of the world.

Of the eight characters which are hereafter given as distinguishing the Herons from the Storks, the Spoonbills and Ibises all agree with the Herons in the 3rd, 4th, and 5th, and with the Storks in the 1st, 2nd, 6th, 7th, and 8th. In fact the Herons differ more *inter se*, and so do the Storks, than the Spoonbills do from the Ibises. The shape of the rostrum seems to be of very little taxonomic importance. Still less importance must be attached to the number of xiphoid processes on each side of the median process of the posterior margin of the sternum; the Madagascar Spoonbill (*Platalea telfairii*) appears to be aberrant in this respect, differing from all the other Spoonbills and Ibises in having only one lateral process on each side.

It is extremely doubtful whether the Ibises have any right whatever to be regarded as a distinct family from the Plataleidae. Except in the characteristic shapes of their bills, they present no differences of importance in their osteology.

The Plataleae seem to be closely related both to the Anseres and to the Herodiones, especially to the Ciconiidae.

HERODIONES.

The Storks and the Herons form a well-defined group of birds, possessing the following characters:—

1. They are heterocœlous in the articulation of their dorsal vertebræ.
2. They are holorhinal in the bifurcation of their nasals.
3. They have only one xiphoid process on each side of the median process of the posterior margin of the sternum.
4. They have no basipterygoid processes.
5. They have no lateral occipital fontanelles.
6. The angle of the mandible is truncated.
7. The palatines either almost or quite coalesce for a short distance after their articulation with the pterygoids, but when they become expanded the laminae separate.
8. The maxillo-palatines are large and spongy, and almost or quite coalesce with each other and with the maxillary processes of the palatines.

The 6th character is sufficient to distinguish the Herodiones from all the other suborders, except from the Steganopodes. To complete the diagnosis, it is necessary to go outside the eight characters enumerated above. The fact that the tarsus happens to be shorter than the outer toe is a sufficient character (though an accidental one) to distinguish the Steganopodes from the Herodiones. A much better character is the fact that in the Steganopodes the quadrate is placed so far behind the postfrontal that it causes the exoccipital to extend behind the foramen magnum, giving a remarkably square appearance to the back of the skull, which is also observable in that of the supposed Ratite ancestor of the Colymbidæ (*Hesperornis*).

The Herodiones number about 90 species, of which about 20 are Ciconiidae and about 70 Ardeidae, but the two families are very closely related. Nature has not drawn a very definite line between them; many of the Storks approach the Herons in one or two of their characters, and many of the Herons possess some Stork-like characters. The principal osteological points in which the Storks differ from the Herons are as follows:—

CICONIIDÆ.

1. The temporal fossæ are obscurely defined.
2. There is no interclavicular process within the angle of the furculum.
3. The episternal process is very small or absent.
4. The coracoids do not overlap at their base.
5. The carotid arches are not complete on any of the cervical vertebræ.
6. The cervical vertebræ are comparatively short.
7. The number of cervical vertebræ is 17.
8. The ilium in front of the acetabulum is comparatively broad.

ARDEIDÆ.

1. The temporal fossæ are very strongly marked.
2. The interclavicle projects conspicuously within the angle of the furculum.
3. The episternal process is very conspicuous.
4. The coracoids overlap at their base.
5. The carotid arches are complete on half a dozen of the cervical vertebræ.
6. The cervical vertebræ are very long.
7. The number of cervical vertebræ is 19.
8. The ilium in front of the acetabulum is comparatively narrow.

Of these eight peculiarities none are characteristic of every species. All that can be said is that every species of Stork agrees with a majority of the characters in the left-hand column, and every species of Heron agrees with a majority of the characters in the right-hand column. The inference to be drawn from these facts is that the differentiation of the two families is a comparatively recent event. In their osteological characters *Tantalus*, *Balaniceps*, and *Scopus* are Storks, but *Cancroma* is a Heron. That *Balaniceps* in tropical Africa, and *Cancroma* in tropical America, should have independently developed "boat-bills," is a remarkable but instructive fact. Not only do these curiously-billed birds belong to different genera, but to different families. *Cancroma* is a typical Heron, possessing every one of the eight characters enumerated above, except that in the 6th character it approaches the Storks. On the other hand, *Balaniceps* is a Stork, and not a Heron, in seven out of the eight characters. In the 5th character it is a Heron, but this peculiarity (that of the two ventral processes on many of the cervical vertebræ meeting to form a carotid arch) appears to be of very little taxonomic value in the Herodiones. In *Ciconia leucocephala*

they meet on one vertebra, and amongst the Ardeidæ the genus *Nycticorax* is aberrant, the two ventral processes seldom quite meeting. *Scopus* is a Stork in all points except the 4th; the coracoids slightly overlap*.

The Herodiones are distributed throughout the temperate and tropical regions of both hemispheres.

STEGANOPODES.

The Peleicans and their allies possess an external character which distinguishes them from all other birds. The hallux is united by a web to the inner toe, so that these birds are completely web-footed. They possess the following osteological characters:—

1. In the articulation of their dorsal vertebræ they may be either heterocœlous or opisthocœlous.

2. They are holorhinal in the bifurcation of their nasals.

3. They may have either one or two lateral xiphoid processes on each side of the median process of the posterior margin of the sternum.

4. They have no basipterygoid processes.

5. They have no lateral occipital fontanelles.

6. The angle of the mandible is truncated.

7. The palatines may or may not coalesce with each other along the whole length of their expanded parts.

8. The maxillo-palatines are large and spongy and coalesce with each other and with the maxillary processes of the palatines.

They may be distinguished from all the other suborders by the 6th character, except from the Herodiones, which have the tarsi much longer than any of the toes.

The Steganopodes contain only half a dozen genera; but, with one exception, these differ so much from each other, that each genus may fairly claim to be placed in a distinct family. With the exception of *Plotus*, which appears to be very nearly allied to *Phalacrocorax*, every genus differs in at

* The Hammer-head further resembles the Storks and differs from the Herons in flying with its neck stretched out, instead of being folded up until the head comes between the shoulders.

least two important characters from each of the other genera. In the following key each genus is treated as a family, but the only distinction between the Plotidæ and the Phalacrocoracidæ is that in the latter the two ventral processes on the 7th to the 13th cervical vertebræ do not meet to form a carotid arch, but they bend towards each other almost sufficiently to do so. In fact the difference between *Phalacrocorax* and *Plotus* appears to be less than that between *Phalacrocorax* and *Fregata* or *Phaethon*. In the latter the ventral processes are short and parallel.

Clavicle ankylosed to sternum.	{	<i>Fregatidæ</i> .	} Several cervical vertebræ with carotid arches.
		<i>Pelecanidæ</i>	
Nasal aperture large. Palatines not coalesced.	{	<i>Sulidæ</i>	
		<i>Plotidæ</i>	
		<i>Phalacrocoracidæ</i> .	} Dorsal vertebræ with ventral processes.
		<i>Phaethontidæ</i> . . .	

In the following key three perhaps less important characters are used to diagnose the families, but *Plotus* is regarded as part of the Phalacrocoracidæ. Which of the two modes of treating *Plotus* is the more scientific must be left for future investigation to determine.

All the dorsal vertebræ heterocœlous.	{	<i>Phaethontidæ</i> .	} Subclavicular process articulating with scapular, but not with clavicle.
		<i>Pelecanidæ</i>	
		<i>Fregatidæ</i>	
Humerus not pneumatic.	{	<i>Phalacrocoracidæ</i> .	
		<i>Sulidæ</i> .	

It is an interesting fact that the egg of *Phaethon* is spotted, and consequently differs from the eggs of all the other genera of the Steganopodes, but the significance of this fact is lessened by the knowledge that *Platalea* is equally aberrant in its suborder.

Phalacrocorax, *Plotus*, and *Sula* are so absolutely similar

in the shape of their palatines that they appear to be more nearly related to each other than to the other genera. The ankylosis of the palatines extends as far as the lachrymals and throughout the whole length of the expanded part. *Fregata* does not differ much in the shape of the palatines at their posterior end, and they are ankylosed as far as the lachrymals, though the distance is much shorter in consequence of the comparative shortness of the frontal; but the lateral expansion of the palatines continues far beyond the lachrymals. In *Phaethon* and *Pelecanus* the palatines are narrowed for some distance from the pterygoids, and expanded for some distance after they separate. In *Pelecanus* the separation takes place in front of the lachrymals, and in *Phaethon* behind them; but having regard to the difference in the length of the bill, the resemblance is very close. *Phaethon* differs, however, from *Pelecanus* in having no absolute coalescence between the two palatines, even where they adjoin.

The Steganopodes appear to be a well-defined group of birds, but, like the Grallæ, they seem to be the remains of a once much larger group, now only represented by comparatively isolated families. They appear to be most nearly allied to the Herodiones. They are distributed throughout the tropical and temperate regions of both hemispheres, and are numerous in individuals, but their total number of species is very small, probably not much exceeding 50.

The families comprising the Ardeino-Anserine Order of Birds may be arranged as follows:—

PALAMEDEÆ.

Palamedeidæ.

ANSERES.

Cygnidæ.

Anatidæ.

PHŒNICOPTERI.

Phœnicopteridæ.

PLATALEÆ.

Plataleidæ.

HERODIONES.

Ciconiidæ.

Ardeidæ.

STEGANOPODES.

Phalacrocoracidæ.

Sulidæ.

Pelecanidæ.

Phaethontidæ.

Fregatidæ.

To what extent the Diurnal Birds of Prey and the Owls differ from the Herodiones and Steganopodes, and whether there are sufficient grounds for placing them in a distinct order, must be the subject of a future paper.

IX.—*On an apparently undescribed Species of Owl from Anjouan Island, proposed to be called Scops capnodes.* By JOHN HENRY GURNEY.

THE Norwich Museum has for some time possessed three specimens of the Scops Owl inhabiting Anjouan Island, in the Comoro group, which have hitherto been catalogued in the collection under the head of *Scops rutilus*, Pucher.; but my attention has been recently called to certain differences, in my opinion specific, between the Anjouan Scops and the Madagascar *Scops rutilus*.

The Norwich Museum contains three Madagascar specimens of *Scops rutilus*, and, through the kind intervention of Professor Newton, I have had the opportunity of examining four others, and also two of the Anjouan Scops, from the Museum at Cambridge.

I have thus had the opportunity of comparing five specimens of Scops from Anjouan with seven from Madagascar, and, as the result of this comparison, I find that in all the